JC02 Rec'd PCT/PTO 28 FEB 2001

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U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: PI-120

U.S. APPLICATION NO. (If known, see 37 CFR 1.5): 09/786012

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/KR99/00811	24 December 1999	01 July 1999

TITLE OF INVENTION Non-Aqueous Electrolyte Composition For Batteries

APPLICANT(S) FOR DO/EO/US Jong Seob Kim, Gyu Young Kim, Tu Won Chang, Kwang Sik Kim, Jin Sung Kim, Ky Hoon Ahn

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
4. [ ] The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - a. [ ] is attached hereto (required only if not communicated by the International Bureau).
   - b. [X] has been communicated by the International Bureau.
   - c [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
7. [ ] Amendments to the claims of the International Application under PCT Article 19(35 U.S.C. 371(c)(3))
   - a [ ] are attached hereto (required only if not communicated by the International Bureau).
   - b [ ] have been communicated by the International Bureau.
   - c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   - d. [ ] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C371(c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5))

Items 11 to 16 below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [ ] Other items or information:

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U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 09/786012	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER

17. [XX] The following fees are submitted:	CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO . . . $1000.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO $860.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO $710.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) $690.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	6 - 20 =	0	X $18.00	$	
Independent claims	1 - 3 =	0	X $80.00	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $270.00	$	
TOTAL OF ABOVE CALCULATIONS =				$ 860.00	
[ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				$	
SUBTOTAL =				$ 860.00	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$ 860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$ 860.00	
				Amount to be refunded:	$
				charged:	$

a. [ ] A check in the amount of $________ to cover the above fees is enclosed.

b. [X] Please charge my Deposit Account No. 19-0065 in the amount of $ 860.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 860.00. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO Customer No.: 23557

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David R. Saliwanchik
NAME

31,794
REGISTRATION NUMBER

February 28, 2001

Patent Application
Docket No. PI-120

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s) : Jong Seob Kim, Young Gyu Kim, Tu Won Chang, Kwang Sik Kim, Jin Sung Kim, Ky Hoon Ahn

Docket No. : PI-120

For : Non-Aqueous Electrolyte Composition For Batteries

PRELIMINARY AMENDMENT

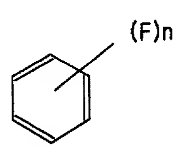
Please amend the above-identified patent application as follows:

In the claims

Claim 1 (amended):

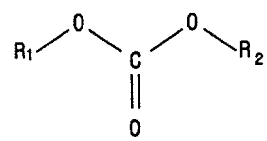
A non-aqueous electrolyte composition for lithium secondary cells, comprising a lithium salt dissolved in an organic solvent system composed of a fluorobenzene component (FB) and a carbonic acid ester component (CE), wherein the solvent components are present in a volume percent ratio range from 50 FB :50 CE to 5 FB : 95 CE, said fluorobenzene component being one or more compounds represented by the following general formula 1:

[Formula 1]



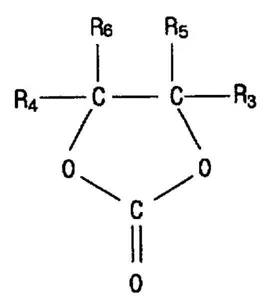
wherein F represents a fluorine element and n is an integer of 1-6; said carbonic acid ester component being one or more compounds represented by the following general formulas 2 and 3:

[Formula 2]



wherein R_1 and R_2, which may be the same or different, each represents an alkyl radical containing 1-4 carbon atoms[.] <u>and</u>

[Formula 3]



wherein R_3, R_4, R_5 and R_6, which may be the same or different, each represents a hydrogen atom or an alkyl radical containing 1-4 carbon atoms.

<u>Claim 2 (amended)</u>:

The [A] non-aqueous electrolyte composition as set forth in claim 1, wherein said fluorobenzene component of the general formula 1 is a mixture of fluorobenzene and difluorobenzene.

<u>Claim 3 (amended)</u>:

The [A] non-aqueous electrolyte composition as set forth in claim 1, wherein said lithium salt is selected from the group consisting of $LiPF_6$, $LiClO_4$, $LiAsF_6$, $LiBF_4$, $LiCF_3SO_3$ and mixtures thereof and used at a concentration of 0.7-2.0 M.

Claim 4 (amended):

The [A] non-aqueous electrolyte composition as set forth in claim 1, wherein said carbonic acid ester component [is] comprises a compound selected from the group consisting of ethylene carbonate, propylene carbonate, butylene carbonate, dimethyl carbonate, diethyl carbonate, dipropyl carbonate, ethylmethyl carbonate, methylpropyl carbonate, and ethylpropyl carbonate [and mixtures thereof].

Claim 5 (amended):

The [A] non-aqueous electrolyte composition as set forth in claim 1, wherein said organic solvent system ranges, in the volume ratio of the solvent component of the general formula 1 to the solvent component of the general formula 2, from 2/1 to 1/10.

Claim 6 (amended):

The [A] non-aqueous electrolyte composition as set forth in claim 1, wherein said organic solvent system ranges, in the volume ratio of the solvent component of the general formula 1 to the solvent component of the general formula 3, from 2/1 to 1/10.

The Commissioner is hereby authorized to charge any fees under 37 CFR 1.16 or 1.17 as required by this paper to Deposit Account 19-0065.

Respectfully Submitted

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NON-AQUEOUS ELECTROLYTE COMPOSITION FOR BATTERIES

TECHNICAL FIELD

The present invention relates, in general, to non-aqueous electrolyte compositions for secondary lithium cells and, more particularly, to non-aqueous electrolyte compositions which allow the cells to be greatly improved in low temperature performance, cell life, and high-temperature dischargeability.

PRIOR ART

Small, slim lithium ion batteries, which are prevalent for use in laptop computers, palmtop computers, camcorders, cellular phones, etc., usually adopt lithium metal-mixed oxides for active cathode materials, carbonaceous materials or metal lithium for active anode materials, and solutions of lithium salts in organic solvents for electrolytes. Conventionally, the organic solvents used for the electrolytes for secondary lithium cells are mixtures of at least two species selected from ethylene carbonate (EC), propylene carbonate (PC), dimethyl carbonate (DMC), diethyl carbonate (DEC), dipropyl carbonate (DPC), ethylmethyl carbonate (EMC), methylpropyl carbonate (MPC), ethylpropyl carbonate(EPC), etc. while a representative example of the lithium salts used is $LiPF_6$.

In recent, the improvement in performance of lithium secondary cells has usually been achieved by selecting appropriate combinations of carbonic acid ester-based solvents, by controlling composition ratios between the solvents used, and/or by recruiting certain additives. In addition, active research has been directed to the development of novel solvents, besides carbonic acid ester-based solvents, in order to improve the properties of electrolytes. For instance, Japanese Pat. Laid-Open Publication No. Heisei 8-287950 discloses a method of improving low temperature performance of cells by use of a solvent in which a fluorine-substituted cyclic carbonate

compound and a carbonate compound are mixed at a volume ratio of 30:70. Japanese Pat. Laid-Open Publication No. Heisei 8-96850 introduces as a solvent a mixture of 20-60 % of vinylene carbonate and a linear carbonate compound so as to improve the cycle life and energy density of a cell. The cycle life of a cell is also extended by use of a solvent comprising butylene carbonate and linear carbonate, according to the disclosure of Japanese Laid-Open Publication No. Heisei 7-326358. U.S. Pat. No. 5,192,629 discloses that, even upon over-charging to the extent of 4.5 V or more, a solvent, in which dimethyl carbonate and ethylene carbonate are mixed at a ratio ranging from 95/5 to 20/80 weight %, is useful to inhibit the electrolyte decomposition owing to oxidation, thereby extending the cycle life of the cell.

Because great differences in cell performance occur depending on kinds of the solvents selected from carbonic acid ester compounds and the mixture ratios of solvents, it is quite difficult to select appropriate solvents and their ratios. Further, vinylene carbonate and butylene carbonate are expensive and thus, economically unfavorable. When certain compounds are used to enhance the performance of cells, they can ameliorate only some properties of cells and may deleteriously affect other properties. For example, an electrolyte composition consisting of dimethyl carbonate and ethylene carbonate gives a contribution to the prolongation of the cycle life of the cell, but deteriorates low temperature performance.

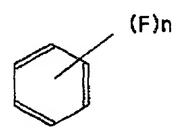
DISCLOSURE OF THE INVENTION

It is an object of the present invention to overcome the above problems encountered in prior arts and to provide a non-aqueous electrolyte for lithium secondary cells, which brings about an improvement in the low temperature performance, high temperature storage, initial capacitance, and cycle life properties of lithium secondary cells.

In accordance with the present invention, there is provided a non-aqueous electrolyte composition for lithium secondary cells, comprising a lithium salt dissolved

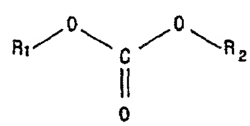
in an organic solvent system composed of a fluorobenzene component (FB) and a carbonic acid ester component (CE), wherein the solvent components are present in a volume percent ratio range from 50 FB : 50 CE to 5 FB : 95 CE, said fluorobenzene component being one or more compounds represented by the following general formula1 :

[Formula 1]



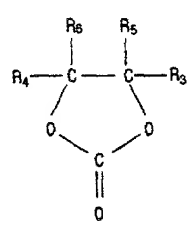
wherein F represents a fluorine element and n is an integer of 1-6; said carbonic acid ester component being one or more compounds represented by the following general formulas 2 and 3:

[Formula 2]



wherein R_1 and R_2, which may be the same or different, each represents an alkyl radical containing 1-4 carbon atoms.

[Formula 3]



wherein R_3, R_4, R_5 and R_6, which may be the same or different, each represents a hydrogen atom or an alkyl radical containing 1-4 carbon atoms.

BEST MODES FOR CARRYING OUT THE INVENTION

The present invention pertains to a mixture of fluorobenzene and carbonic acid ester, useful for a non-aqueous electrolyte for lithium cells.

Examples of the fluorobenzene compound represented by the general formula 1 include fluorobenzene, difluorobenzene, trifluorobenzene, tetrafluorobenzene, pentafluorobenzene and hexafluorobenzene. These compounds may be used alone or in combination. This fluorobenzene solvent component appropriately coordinates lithium ions to effect high conductivity at low temperatures. In addition, the fluorobenzene solvent is 4.5 V or higher in linear sweep voltametry (LSV), showing resistance to the electrolyte decomposition reaction at a cathode upon charging. Consequently, the fluorobenzene solvent improves not only low temperature properties, but also life performance of cells.

In the present invention, carbonic acid ester which composes the organic solvent for the electrolyte, is a cyclic carbonate of the general formula 3, a chain carbonate of the general formula 2, or a mixture thereof. The cyclic carbonate of the general formula 3 is exemplified by ethylene carbonate, propylene carbonate, and butylene carbonate. As for the chain carbonate of the general formula 2, its examples include dimethyl carbonate, diethyl carbonate, dipropyl carbonate, methylpropyl carbonate, ethylmethyl carbonate, ethylpropyl carbonate, etc. The above-exemplified carbonate compounds may be used alone or in combination.

In the solvent mixture of fluorobenzene and carbonic acid ester, the fluorobenzene compound of the general formula 1 preferably amounts 5 to 50 % by volume while the carbonic acid ester of the general formula 2 and/or 3 ranges from 50 to 95 % by volume, correspondingly. For example, when the fluorobenzene compound of the general formula 1 is over 50 % by volume, phase separation of the solvent components used occurs, along with the solidification of the lithium salt, at low temperatures, deteriorating the low temperature performance and the life properties of the cells. On the other hand, if the fluorobenzene compound is used at an amount of

less than 5 % by volume, almost no addition effects are obtained on cell performance. Under this condition, the preferable volume ratio of the compound of the general formula 1 to the compound of the general formula 2 is in a range of 2:1 - 1:10. This volume range is also true of the ratio of the compound of the general formula 1 to the compound of the general formula 3.

Useful as the lithium salt are one or more compounds selected from $LiPF_6$, $LiClO_4$, $LiCF_3SO_3$, $LiAsF_6$, and $LiBF_4$. The salt ranges, in concentration, from 0.7 to 2.0 M. For example, when the salt has a concentration of less than 0.7 M, the electrolyte is too low in electroconductivity to function well. On the other hand, if the concentration of the electrolyte exceeds 2.0 M, an increase is brought about in the viscosity at low temperatures, giving rise to a decrease in the mobility of lithium ions and thus, in the low temperature performance of the cell.

A better understanding of the present invention may be obtained in light of the following examples which are set forth to illustrate, but are not to be construed to limit the present invention.

EXAMPLES 1 THROUGH 5

In these examples, one compound was selected from each of the solvent groups respectively represented by the general formulas 1 to 3 and the selected solvent compounds were mixed at different ratios within the effective range of the invention.

In Example 1, ethylene carbonate (EC), dimethyl carbonate (DMC) and fluorobenzene (FB) were mixed at a volume ratio of 1:1:1 while $LiPF_6$ was dissolved as a solute. The electrolyte thus obtained was used to prepared a 18650 cylindrical cell, after which an examination was made of the discharge/charge capacity ratio (%) after a first charge/discharge cycle, the discharge/nominal capacity ratio (%) at -20 °C, and the discharge/nominal capacity ratio (%) after 150 cycles to evaluate the life performance of the cell. The results are given in Table 1, below. In the cell, carbon black was used as an active material for the anode, polyvinylidenefluoride (PVDF) as a binder,

$LiCoO_2$ as an active material for the cathode, and acetylene black as a current collector.

In Examples 2 through 5, the same procedure as in Example I was repeated except that the volume ratios of the solvent components were used according to the instruction of Table 1, below. The properties of the cells thus prepared were measured and are given in Table 1.

COMPARATIVE EXAMPLE 1

A cell was prepared in a similar manner to that of Example 1, except that a mixture of 1:1 ethylene carbonate (EC):dimethyl carbonate (DMC) was used as a solvent for the electrolyte. The evaluation of the properties of the cell is shown in Table 1, below.

[TABLE 1]

Nos. of Exmpl.	Vol. Ratio of Solvents	% Discharge/ Charge Capacity after 1st cycle	% Discharge/ Nominal Capacity at -20 °C	% Discharge/ Nominal Capacity after 150 Cycles
1	EC:DMC:FB =1:1:1	93.8	83.4	85.5
2	EC:DMC:FB =4:4:1	93.4	74.3	84.3
3	EC:DMC:FB	93.6	82.6	85.2

	=2:2:1			
4	EC:DMC:FB =2:1:2	93.9	75.5	83.0
5	EC:DMC:FB =1:1:2	94.1	60.8	81.3
C. 1	EC:DMC=1:1	93.4	23.7	84.3

Note : EC=ethylene carbonate, DMC=dimethyl carbonate
FB=fluorobenzene

EXAMPLES 6 THROUGH 10

In these examples, mixtures of the compounds selected from the general formulas 1 to 3, were used as solvents for the electrolyte with the solvent component of the general formula 1 being changed according to examples.

In Example 6, a mixture of 3:3:1:1 ethylene carbonate (EC) : diemthyl carbonate (DMC) : diethyl carbonate (DEC) : fluorobenzene (FB) was used as a solvent to prepare a cell. An examination was made of the discharge/charge capacity ratio (%) after storage at a high temperature (60 °C), the discharge/nominal capacity ratio (%) at -20 °C, and the discharge/nominal capacity ratio (%) after 300 cycles to evaluate the life performance of the cell. The results are given in Table 2, below.

In Examples 7 through 10, the same procedure as in Example 6 was repeated except that the solvent components were used according to the instruction of Table 2, below. The cells thus prepared were measured for the above properties and the results are given in Table 2.

COMPARATIVE EXAMPLES 2 AND 3

Cells were prepared in a similar manner to that of Example I, except that solvents were used as indicated in Table 2, below. The evaluation of the properties of the cells was conducted as in Example 6 and the results are shown in Table 2, below.

TABLE 2

Nos. of Exmpl.	Vol. Ratio of Solvents	% Dischargeability after Storage at High Temp.	% Discharge/ Nominal Capacity at -20 °C	% Discharge/ Nominal Capacity after 300 Cycles
6	EC:DMC:DEC:FB =3:3:1:1	89.2	84.5	84.2
7	EC:DMC:DEC:1,2-DFB =3:3:1:1	89.0	84.1	81.0
8	EC:DMC:DEC:1,3-DFB =3:3:1:1	89.2	83.5	78.5
9	EC:DMC:DEC:1,4DFB =3:3:1:1	89.2	84.2	80.3

10	EC:DMC:DEC:1,2,4-TFB =3:3:1:1	88.3	81.3	77.5
C.2	EC:DMC=1:1	87.5	28.7	81.5
C.3	EC:DMC:DEC=3:3:1	85.5	83.1	76.1

Note : EC=ethylene carbonate, DMC=dimethyl carbonate
DEC=diethyl carbonate, FB=fluorobenzene
DFB=difluorobenzene, TFB=trifluorobenzene

EXAMPLES 11 THROUGH 15

In these examples, two compounds of the general formula 3, and one compound of each of the general formulas 1 and 2, were mixed at different ratios within the volume range of the present invention and evaluated for their influence on the properties of cells, especially standard capacity against nominal capacity. Ethylene carbonate (EC), dimethyl carbonate (DMC), propylene carbonate (PC), and fluorobenzene (FB) were mixed at volume ratios according to the instructions of Table 3, below, to prepare cells. An examination was made of the standard capacity/nominal capacity ratio (%), the discharge/nominal capacity ratio (%) at -20 °C, and the discharge/nominal capacity ratio (%) after 300 cycles to evaluate the life performance of the cell. The results are given in Table 3, below.

COMPARATIVE EXAMPLES 4 THROUGH 7

Cells were prepared in a similar manner to that of Example 1, except that solvents were used as indicated in Table 3, below. The evaluation of the properties of the cells was conducted as in Example 1 and the results are shown in Table 3, below.

TABLE 3

Nos. of Exmpl.	Vol. Ratio of Solvents	% Standard/ Nominal Capacity	% Discharge/ Nominal Capacity at -20 °C	% Discharge/ Nominal Capacity after 300 Cycles
11	EC:DMC:PC:FB =4:4:0.5:1.5	100.5	84.3	84.5
12	EC:DMC:PC:FB =4:3.5:1:1.5	99.6	80.9	85.5
13	EC:DMC:PC:FB =3.5:4:0.5:2	100.7	85	88.0
14	EC:DMC:PC:FB =3.5:3.5:1:2	100.1	82.2	87.8
15	EC:DMC:PC:FB =3:2.5:0.5:4	100.5	85.5	81
C.4	EC:DMC:PC =4.5:4.5:1	97.5	65.1	80.5
C.5	EC:DMC:PC	95.3	47.3	72.1

	=4,5:4.5:1			
C.6	EC:EMC:PC =4.5:4.5:1	96.5	67.4	74.0
C.7	EC:DMC:PC:TFT =3:3:1:1	95.5	75.4	35 (after 200 cycles)

Note : EC=ethylene carbonate, DMC=dimethyl carbonate
PC=propylene carbonate, EMC=ethylmethyl carbonate
FB=fluorobenzene, TFT=ααα-fluorotoluene

Assay for Physical Properties

* Low Temperature Dischargeability (%Discharge capacity/nominal capacity at -20 °C): when a cell was charged at 0.2 C to the potential of 4.1 V, allowed to stand at -20 °C for 16 hours, and discharged at 0.2 C to the potential of 2.75 V, the capacity decrease was measured.

* Cycle Life (%Discharge capacity/nominal capacity after cycles): after 150-300 cycles, each cycle consisting of charging up to 4.1 V and discharging down to 2.75 V at 1 C, a cell was measured for the decrease of cell capacity.

* High Temperature Storage Test (% Discharge capacity after storage at 60 °C): a cell was charged at 0.5 C to 4.1 V, allowed to stand at 60 °C for 30 days, and discharged at 0.2 C to 2.75 V, followed by measuring the decrease of cell capacity (discharge capacity/nominal capacity).

* Standard Capacity: cell capacity shown when a cell was discharged at 1 C to 2.75 V after being charged at 0.5 C to 4.1 V.

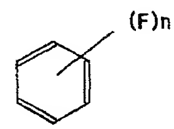
As described hereinbefore, the non-aqueous electrolyte composition of the present invention has a significant advantage over conventional electrolyte compositions employing carbonic acid ester solvents only, in terms of low temperature performance, cell life, and high-temperature dischargeability.

The present invention has been described in an illustrative manner, and it is to be understood that the terminology used is intended to be in the nature of description rather than of limitation. Many modifications and variations of the present invention are possible in light of the above teachings. Therefore, it is to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

CLAIMS

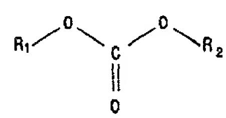
1. A non-aqueous electrolyte composition for lithium secondary cells, comprising a lithium salt dissolved in an organic solvent system composed of a fluorobenzene component (FB) and a carbonic acid ester component (CE), wherein the solvent components are present in a volume percent ratio range from 50 FB :50 CE to 5 FB : 95 CE, said fluorobenzene component being one or more compounds represented by the following general formula 1:

[Formula 1]



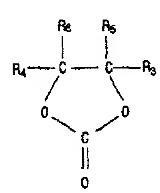
wherein F represents a fluorine element and n is an integer of 1-6; said carbonic acid ester component being one or more compounds represented by the following general formulas 2 and 3:

[Formula 2]



wherein R_1 and R_2, which may be the same or different, each represents an alkyl radical containing 1-4 carbon atoms.

[Formula 3]



wherein R_3, R_4, R_5 and R_6, which may be the same or different, each represents a hydrogen atom or an alkyl radical containing 1-4 carbon atoms.

2. A non-aqueous electrolyte composition as set forth in claim 1, wherein said fluorobenzene component of the general formula 1 is a mixture of fluorobenzene and difluorobenzene.

3. A non-aqueous electrolyte composition as set forth in claim 1, wherein said lithium salt is selected from the group consisting of $LiPF_6$, $LiClO_4$, $LiAsF_6$, $LiBF_4$, $LiCF_3SO_3$ and mixtures thereof and used at a concentration of 0.7-2.0 M.

4. A non-aqueous electrolyte composition as set forth in claim 1, wherein said carbonic acid ester component is selected from the group consisting of ethylene carbonate, propylene carbonate, butylene carbonate, dimethyl carbonate, diethyl carbonate, dipropyl carbonate, ethylmethyl carbonate, methylpropyl carbonate, ethylpropyl carbonate and mixtures thereof.

5. A non-aqueous electrolyte composition as set forth in claim 1, wherein said organic solvent system ranges, in the volume ratio of the solvent component of the general formula 1 to the solvent component of the general formula 2, from 2/1 to 1/10.

6. A non-aqueous electrolyte composition as set forth in claim 1, wherein said organic solvent system ranges, in the volume ratio of the solvent component of the general formula 1 to the solvent component of the general formula 3, from 2/1 to 1/10.

Docket No. PI-120

DECLARATION (37 CFR 1.63) AND POWER OF ATTORNEY

As a below-named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name; and

I believe that I am the original, first, and sole inventor (if only one name is listed below), or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled "NON-AQUEOUS ELECTROLYTE COMPOSITION FOR BATTERIES", specification for which

☒ is attached hereto.

☐ was filed ____________, Serial No. ____________.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code §119 and/or §365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Application Serial No.	Country	Filing Date	Priority Claimed
99-26358	Republic of Korea	July 1, 1999	Yes

I hereby claim priority benefits under Title 35, United States Code §119 of any provisional application(s) for patent listed below:

Application Serial No.	Filing Date	Priority Claimed

I hereby claim the benefit under Title 35, United States Code, §120 and/or §365 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No.	Filing Date	Status (Patented, Pending, Abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following persons registered to practice before the Patent and Trademark Office as my attorneys with full power of substitution and revocation to prosecute this application and all divisions and continuations thereof and to transact all business in the Patent and Trademark Office connected therewith: David R. Saliwanchik, Reg. No. 31,794; Jeff Lloyd, Reg. No. 35,589; Doran R. Pace, Reg. ~~No. 38,261;~~ Christine Q. McLeod, Reg. No. 36,213; Jean Kyle, Reg. No. 36,987; Jay M. Sanders, Reg. No. 39,355; James S. Parker, Reg. No. 40,119; Frank C. Eisenschenk., Reg. No. 45,332, and Seth M. Blum, Reg. No. P-45,489.

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Docket No. PI-125

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